What is claimed is:

1. A device for separating particles of relatively high mass/charge ratios (M_1) from particles of relatively low mass/charge ratios (M_2), said device comprising:

a cylinder having a first end and a second end with a wall extending therebetween to define a chamber with a longitudinal axis;

a means for generating an axially aligned magnetic field (B_z) in said chamber;

a plurality of substantially rectangular shaped coils mounted on said wall of said cylinder with each coil having a pair of opposed sides oriented substantially longitudinally, and a pair of opposed sides oriented substantially azimuthally relative to the axis;

a means for sending alternating electrical currents through each said coil wherein the current in each said coil has a phase difference relative to the current in an adjacent said coil to generate a magnetic field (B_0) in said chamber that is aligned substantially perpendicular to the axis and rotates about the axis; and

a means for introducing a multi-species plasma into said chamber for interaction with said rotating magnetic field (B_0) to rotate said plasma in said axially oriented magnetic field component (B_z) and induce a radially oriented electric field (E_r) in said chamber to separate particles M_1 from particles M_2 in the crossed electric and magnetic fields ($E_r \times B_1$).

2. A device as recited in claim 1 having four said coils with the alternating current in each said coil having a phase difference of ninety degrees (90°) relative to the alternating current in each adjacent said coil.

3. A device as recited in claim 1 further comprising a first plurality of electrodes at said first end and a second plurality of electrodes at said second end.

4. A device as recited in claim 3 further comprising a means for connecting said electrodes to ground with at least one resistor interconnected between said electrodes and ground to allow the electric field (E_r) to charge up.

5. A device as recited in claim 3 wherein said first plurality of electrodes include a plurality of passive ring electrodes concentrically mounted at said first end of said chamber and said second plurality of electrodes include a plurality of passive ring electrodes concentrically mounted at said second end of said chamber.

6. A device as recited in claim 1 wherein the plasma is introduced into said chamber through said first end thereof and said device further comprises a collector at said second end of said chamber for collecting the particles M_2.

7. A device as recited in claim 1 wherein the particles M_1 are collected on said wall of said cylinder.

8. A device for separating particles with relatively high mass to charge ratios (M_1) from particles with relatively low mass to charge ratios (M_2), said device comprising:

a means for rotating a magnetic field about an axis;

a means for introducing a multi-species plasma containing particles M_1 and particles M_2 into the rotating magnetic field to rotate the multi-species plasma; and

a means for establishing a substantially axially aligned magnetic field for interaction with said rotating multi-species plasma to induce a radially oriented electric field and separate the particles M_1 from the particles M_2 in the axially aligned magnetic field and radially oriented electric field.

9. A device as recited in claim 8 further comprising a cylinder having a first end and a second end with a wall extending therebetween to define a chamber around the axis for holding the plasma during interaction of the plasma with the electric and magnetic fields.

10. A device as recited in claim 9 wherein said rotating means comprises a plurality of substantially rectangular shaped coils mounted on said wall of said cylinder with each coil having a pair of opposed sides oriented substantially longitudinally, and a pair of opposed sides oriented substantially azimuthally relative to the axis.

11. A device as recited in claim 10 wherein said rotating means further comprises a multi-phase alternating current source for sending electrical currents through said coils wherein the current in each said coil has a phase difference relative to the current in an adjacent said coil.

12. A device as recited in claim 11 having four said coils with the alternating current in each said coil having a phase difference of ninety degrees (90°) relative to the alternating current in each adjacent said coil.

13. A device as recited in claim 12 further comprising a first plurality of electrodes at said first end and a second plurality of electrodes at said second end.

14. A device as recited in claim 13 further comprising a means for connecting said electrodes to ground with at least one resistor interconnected between said electrodes and ground to allow the electric field (E) to charge up and wherein said first plurality of electrodes include a plurality of passive ring electrodes concentrically mounted at said first end of said chamber and said second plurality of electrodes include a plurality of passive ring electrodes concentrically mounted at said second end of said chamber.

15. A device as recited in claim 9 wherein the plasma is introduced into said chamber through said first end thereof and said device further comprises a collector at said second end of said chamber for collecting the particles M_2 and wherein the particles M_1 are collected on said wall of said cylinder.

16. A method for separating particles of relatively high mass/charge ratios (M_1) from particles of relatively low mass/charge ratios (M_2) which comprises the steps of:

rotating a magnetic field about an axis;

introducing a multi-species plasma containing particles M_1 and particles M_2 into the rotating magnetic field to rotate the multi-species plasma; and

establishing a substantially axially aligned magnetic field for interaction with said rotating multi-species plasma to induce a radially oriented electric field and separate the particles M_1 from the particles M_2 in the axially aligned magnetic field and radially oriented electric field.

17. A method as recited in claim 16 further comprising the step of providing a cylinder having a first end and a second end with a wall extending therebetween to define a chamber around the axis for holding the plasma during interaction of the plasma with the electric and magnetic fields.

18. A method as recited in claim 17 wherein said rotating step is accomplished using four substantially rectangular shaped coils mounted on said wall of said cylinder with each coil having a pair of opposed sides oriented substantially longitudinally, and a pair of opposed sides oriented substantially azimuthally relative to the axis.

19. A method as recited in claim 18 further comprising the step of sending an electrical current through respective said coils wherein the current in each said coil is an alternating current with the alternating current in each said coil having a phase difference of ninety degrees (90°) relative to the alternating current in each adjacent said coil to accomplish said rotating and said establishing steps.

20. A method as recited in claim 19 further comprising the steps of:

mounting at least one electrode at a said end of said wall for interaction with the plasma;

electrically connecting said electrode to a resistor; and

electrically connecting said resistor to ground.